

Allelopathy in algal bloom formation? A (allelo)pathetic story...

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In its broadest sense, this research aims to assess the present and future risk for harmful algal bloom (HAB) development in Belgian coastal waters. Throughout the last century, these types of events have gradually spread across the globe and have dramatically increased in size, frequency and severity. The hypoxia, physical disturbance, food-web disruption and marine toxins associated with these events can lead to mass mortalities of marine life at all trophic levels. Never before has such an abundance of toxic species and algal toxins caused this much food-web disruption, biodiversity loss and economic costs. Worryingly, these events are predicted to become even more prevalent as climate change starts to take hold. Despite well over 50 years of research into bloom dynamics of harmful algae, the abiotic conditions and biotic interactions leading up to a full scale harmful algal bloom are not fully understood. Understanding these processes is, however, paramount to improve the prediction, mitigation and management of the risks HABs pose to both human health and the coastal environment.

Toxic phytoplankton has been shown to suppress the growth or performance of other benign phytoplankton species. This process is referred to as allelopathy and allelochemicals are a prevalent property of many HAB species. Yet, to date, not a single experimental study has demonstrated the importance of these interactions for the successful development of a bloom. Here, two toxic species - *Alexandrium minutum* and *Protoceratium reticulatum* - were made to compete with a non-toxic species *Prorocentrum micans* for nutrients and overall community dominance. Algal cultures of all conceivable combinations were made in which each of the three species were added at initial densities of 0, 10 or 100 cells.ml⁻¹. Anthropogenic influences were simulated by varying the N:P ratio (8 and 14) and the inclusion of an IPCC's worst case climate change scenario (20 and 24°C). Each treatment was replicated three times. Algal densities were determined twice a week over an exposure period of 68 days.

Allelopathic interactions were ultimately not needed to fit the outcomes of our experiments. Using a resource-utilization model, differences in resource assimilation rates alone could accurately predict the interspecific competition. The non-toxic dinoflagellate *Prorocentrum micans* was found to be a very strong competitor - often dominating the overall phytoplankton community despite an initial numerical disadvantage. The initial starting densities could, however, inverse the outcome of competition between *A. minutum*, which has a slower nitrogen assimilation rate, and *P. micans*. *Protoceratium reticulatum* was a poor competitor but is known to bloom occasionally. This may indicate that other biotic parameters, such as grazing deterrence, may play a more important role in the successful development of HABs (experiments on-going). Despite its effect on growth rates, an increased temperature was not found to determine the outcome of the experiment as identical patterns were found for across all temperature and nutrient conditions.

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